IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent Application

Applicant(s):	Azadet et al.
Case:	15-7
Serial No.:	10/022,665
Filing Date:	December 18, 2001
Group:	2133
Examiner:	Joseph D. Torres
Title:	Method and Apparatus for Joint Equalization and Decoding of Multidimensional Codes Transmitted over Multiple Symbol Durations

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REPLY BRIEF

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Appellant hereby replies to the Examiner's Answer, mailed May 1, 2007 (referred to hereinafter as "the Examiner's Answer"), in an Appeal of the final rejection of 1, 2-4, 9, 10, 21-27 and 33-34 in the above-identified patent application

REAL PARTY IN INTEREST

A statement identifying the real party in interest is contained in Appellant's Appeal Brief

RELATED APPEALS AND INTERFERENCES

A statement identifying related appeals is contained in Appellant's Appeal Brief

STATUS OF CLAIMS

A statement identifying the status of the claims is contained in Appellant's Appeal

Brief.

STATUS OF AMENDMENTS

A statement identifying the status of the amendments is contained in Appellant's Appeal Brief.

SUMMARY OF CLAIMED SUBJECT MATTER

A Summary of the Invention is contained in Appellant's Appeal Brief.

STATEMENT OF GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

A statement identifying the grounds of rejection to be reviewed on appeal is contained in Appellant's Appeal Brief.

CLAIMS APPEALED

A copy of the appealed claims is contained in an Appendix of Appellant's Appeal Brief

ARGUMENT

Independent Claims 1, 21 and 33

The Examiner rejected independent claims 1, 21 and 33 under 35 U.S.C. §103(a) as being unpatentable over Chevillat in view of Kim. The Examiner acknowledges that Chevillat does not explicitly teach the use of taking specific compensatory actions for intrasymbol interference. The Examiner asserts, however, that Kim teaches compensation for intrasymbol interference (citing col. 9, lines 8-13).

In summary, Appellants submit that neither Chevillat nor Kim, separately or in combination, disclose or suggest compensating for ***intra***symbol interference caused by symbol components within a current multidimensional code symbol.

Patentable Weight of "Multidimensional Code Symbol" Definition

In the Examiner's Answer, the Examiner appears to concede that the preamble language "a multidimensional code symbol comprises a number of symbol components of lower

dimensionality," should be given patentable weight (although the Examiner asserts this limitation is taught by Kim, as addressed below). As asserted by Appellants in the Appeal Brief, the above quoted limitation " caused by symbol components within a current multidimensional code symbol," must be interpreted in light of the preamble. The term "multidimensional code symbol" is defined in the preamble to comprise "a number of symbol components of lower dimensionality," and thus, this recitation **must** be given patentable weight. The body of the claim depends on the preamble for completeness. There is no basis in law or fact for overlooking the explicit definition of the term "multidimensional code symbol," in the manner suggested by the Examiner.

In the Examiner's Answer, page 12, second paragraph, the Examiner asserts that the phrase "*caused by symbol components within a current multidimensional code symbol*," from the final step of claim 1, "adds nothing" to the statement "compensating for intrasymbol interference" (since intrasymbol interference inherently is caused by internal components). What the phrase "adds", however, is that what is being addressed is intrasymbol interference *in a* ***multidimensional*** *code symbol!* The "multidimensional code" issue is developed further below.

Intrasymbol Interference Compensation Within Multidimensional Code

Independent claims 1, 21 and 33 require compensating for intrasymbol interference caused by symbol components within a current *multidimensional* code symbol. In the final Office Action and Examiner's Answer, the Examiner asserts that Kim teaches compensation for intrasymbol interference (citing col. 9, lines 8-13). Appellants submit that the references, when combined, do not disclose or suggest compensating for intrasymbol interference caused by symbol components within a current **multidimensional code** symbol.

Multiple One-Dimensional Components is Not a Multidimensional Symbol

In the Examiner's Answer, page 11, first paragraph, the Examiner asserts that in-phase error and quadrature-phase error components are "one-dimensional components of a two-dimensional code symbol" (noting that in-phase refers to the one-dimensional cosine carrier and and quadrature-phase refers to the one-dimensional sine carrier of a transmitted two dimensional signal). Appellants note that the term "dimension" does not even appear in Kim. Although not stated or developed by the Examiner, it is assumed that the Examiner is asserting that somehow a one-dimensional sine carrier and one-dimensional cosine carrier collectively comprise a two-

dimensional signal. Rather, Kim is addressing a signal comprised of two different one-dimensional components. The Examiner's assertion is **contrary** to the accepted meaning of the term "multidimensional code" by those of ordinary skill in the art

Appellants maintain that ***Kim is not directed to a coded system (let alone a multidimensional coded system)!*** Thus, Kim does not disclose or suggest compensating for **intra**symbol interference within **multidimensional code** symbols. Kim defines intrasymbol interference in the context of in-phase and quadrature-phase filtering in an OFDM transceiver *without consideration of coding*. In the Examiner's Answer, the Examiner merely asserts, on page 13, final paragraph, that *Chevillat* teaches two-dimensional trellis coded symbols. The Examiner is apparently conceding that Kim does not address multi-dimensional *coded* symbols.

Thus, neither Chevillat nor Kim, alone or in combination, address compensating for **intra**symbol interference ***within*** a current *multidimensional code* symbol. Chevillat may teach teach two-dimensional trellis coded symbols, and Kim may teach intrasymbol interference compensation, but neither reference teaches "compensating for **intra**symbol interference ***within*** a current *multidimensional code* symbol," as required by each independent claim.

No Motivation to Combine

First, as noted in Appellants' Appeal Brief, since Kim is not even directed to a *coded system*, a person of ordinary skill in the art would not even look to Kim for a solution to the problem addressed by the present invention, namely, the decoding of multidimensional codes. Thus, a person of ordinary skill would not combine Chevillat and Kim.

On page 14, second paragraph, of the Examiner's Answer, the Examiner asserts that the Equalizer in Kim would operate on any 2-dimensional symbol as taught in Kim. The Examiner has no support for the assumption that Kim could operate on the two-dimensional trellis coded symbols of Chevillat. Likewise, on page 17, second paragraph, of the Examiner's Answer, the Examiner asserts that the equalizer in Kim is operative to receive and equalize any received 2-dimensional symbol. Appellants again assert that there is no disclosure or suggestion in Kim of multi-*dimensional* code symbols and it is purely speculative to assert that Kim is operative to receive and equalize ***any*** received 2-dimensional symbol.

Also, there is no reasonable expectation of success for the combination of Chevillat and Kim. Kim suggests to "to remove intrasymbol interferency by updating the in-

phase and quadrature phase filtering coefficients by utilizing the pilot signal," which is different from "compensating for intrasymbol interference caused by symbol components within a current multidimensional code symbol." Kim addresses the removal of intrasymbol interference for an uncoded symbol comprising I and Q coordinates, whereas claim 1 addresses the compensation of intrasymbol interference caused by symbol components within a current multidimensional code symbol. It is not clear to Appellants how the removal of in-phase and quadrature-phase filtering coefficients by utilizing the pilot signal leads to the compensation of intrasymbol interference caused by symbol components within a current code symbol. Therefore, there is no reasonable expectation of success.

Thus, Appellants respectfully request withdrawal of the Section 103 rejection of the independent claims.

Claims 2 and 4

The Examiner incorrectly referenced the limitations of claim **3** when discussing claim **2** in the Examiner's Answer.

Claims 2 and 4 are rejected under 35 U.S.C. §103(a) as being unpatentable over Chevillat and Kim in view of Eyuboglu. Regarding claim 2, the Examiner acknowledges that Chevillat and Kim do not explicitly teach the specific use of multidimensional Trellis code constellations, but asserts that Eyuboglu teaches this limitation (col. 8 and 4D Block Encoder 97 in FIG. 7). Regarding claim 4, the Examiner asserts that Eyuboglu teaches calculating intersymbol interference estimates based on said previously decoded multidimensional code symbols (col. 4, lines 61-65, in Eyuboglu) and calculating branch metrics based on a received signal and said intersymbol interference and intrasymbol interference estimates (col. 3, lines 1-2, in Eyuboglu); and that Kim teaches calculating intrasymbol interference estimates based on possible data symbol values (col. 9, lines 8-13, in Kim).

Appellants again respectfully submit that the Examiner has failed to establish a *prima facie* case of obviousness for at least the reason that there exists no motivation to combine the references, and further, even if combinable, the references collectively do not teach each and every limitation of the independent claims. Appellants could find no disclosure or suggestion in the cited references to combine the techniques of Eyuboglu with the inventions of either Chevillat or Kim. Claim 2 requires wherein multidimensional code symbols are transmitted over

more than one symbol interval that is used to transmit one of said symbol components and claim 4 requires calculating intrasymbol interference estimates based on possible data symbol values; and calculating branch metrics based on a received signal and said intersymbol interference and intrasymbol interference estimates

Thus, Chevillat, Kim, and Eyuboglu, alone or in any combination, do not disclose or suggest wherein multidimensional code symbols are transmitted over more than one symbol interval that is used to transmit one of said symbol components, as required by claim 2, and do not disclose or suggest calculating intrasymbol interference estimates based on possible data symbol values; and calculating branch metrics based on a received signal and said intersymbol interference and intrasymbol interference estimates

, as required by claim 4

Conclusion

The rejections of the cited claims under section 103 in view of Chevillat, Kim, and Eyuboglu, alone or in any combination, are therefore believed to be improper and should be withdrawn The remaining rejected dependent claims are believed allowable for at least the reasons identified above with respect to the independent claims

The attention of the Examiner and the Appeal Board to this matter is appreciated.

Respectfully,

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Date: June 29, 2007

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APPENDIX

1 A method for decoding a multidimensional code, wherein a multidimensional code symbol comprises a number of symbol components of lower dimensionality, said method comprising the steps of:

compensating for intersymbol interference caused by previously transmitted multidimensional code symbols by calculating intersymbol interference estimates based on one or more multidimensional code symbols; and

compensating for intrasymbol interference caused by symbol components within a current multidimensional code symbol.

2 The method of claim 1, wherein multidimensional code symbols are transmitted over more than one symbol interval that is used to transmit one of said symbol components.

3. The method of claim 1, wherein said multidimensional code symbol comprises a number of transmitted symbol components of lower dimensionality that exceeds a number of available channels.

4 The method of claim 1, further comprising the steps of:

calculating intrasymbol interference estimates based on possible data symbol values; and

calculating branch metrics based on a received signal and said intersymbol interference and intrasymbol interference estimates.

5 (Cancelled)

6 (Cancelled)

7. (Cancelled)

8. (Cancelled)

9. The method of claim 1, further comprising the step of determining a best surviving path into a trellis state

10. The method of claim 1, wherein said multidimensional code is 4D-TCM

11-20. (Cancelled)

21. A system for decoding a multidimensional code, wherein a multidimensional code symbol comprises a number of symbol components of lower dimensionality, said system comprising:

means for compensating for intersymbol interference caused by previously transmitted multidimensional code symbols by calculating intersymbol interference estimates based on one or more multidimensional code symbols; and

means for compensating for intrasymbol interference caused by symbol components within a current multidimensional code symbol.

22. The method of claim 1, further comprising the step of calculating a metric for an initial symbol component using survivor symbols from a corresponding state to account for intersymbol interference, wherein said metric is used for the calculation of a branch metric

23. The method of claim 22, further comprising the step of calculating a metric for a subsequent symbol component using survivor symbols from a corresponding state to account for intersymbol interference and using at least one data estimate to account for intrasymbol interference

24. The method of claim 23, further comprising the step of calculating a combined metric by combining said metric for said initial symbol component and said metric for said subsequent symbol component.

25. The method of claim 24, further comprising the step of computing a branch metric for a transition in a trellis using said combined metric.

26. The method of claim 1, further comprising the step of calculating an intersymbol interference-free estimate using at least one survivor symbol from a survivor path

27. The method of claim 26, wherein said intersymbol interference-free estimate is computed for a first and a subsequent symbol interval.

28 The method of claim 27, further comprising the step of calculating an intersymbol interference and intrasymbol interference-free estimate based on said intersymbol interference-free estimate for said subsequent symbol interval and a data symbol that was determined based on said intersymbol interference-free estimate for said first symbol interval

29. The method of claim 28, further comprising the step of computing a distance metric for said first symbol interval based on said intersymbol interference-free estimate for said first symbol interval.

30. The method of claim 29, further comprising the step of computing a distance metric for said subsequent symbol interval based on said intersymbol interference and intrasymbol interference-free estimate

31. The method of claim 30, further comprising the step of computing a branch metric for a transition in a trellis based on said distance metrics for said first and subsequent symbol intervals

32. The method of claim 31, further comprising the step of computing the best path into a state in said trellis

33. A system for decoding a multidimensional code, wherein a multidimensional code symbol comprises a number of symbol components of lower dimensionality, comprising:

a decision feedback unit for compensating for intersymbol interference caused by previously transmitted multidimensional code symbols by calculating intersymbol interference estimates based on one or more multidimensional code symbols; and

a branch metrics unit for compensating for intrasymbol interference caused by symbol components within a current multidimensional code symbol.

34 The system of claim 33, wherein said multidimensional code symbol comprises a number of transmitted symbol components of lower dimensionality that exceeds a number of available channels.

EVIDENCE APPENDIX

There is no evidence submitted pursuant to § 1.130, 1.131, or 1.132 or entered by the Examiner and relied upon by appellant.

RELATED PROCEEDINGS APPENDIX

There are no known decisions rendered by a court or the Board in any proceeding identified pursuant to paragraph (c)(1)(ii) of 37 CFR 41.37.